

# United States Patent [19]

[11] 3,867,239

Alesi et al.

[45] Feb. 18, 1975

[54] <b>BODY ARMOR CONSTRUCTION</b>	274,354	3/1883	McCarthy et al.....	52/592
[75] Inventors: <b>Anthony L. Alesi, Wayland; Verne E. Stimpert, Abington; Roger A. Gagne, Natick, all of Mass.</b>	1,268,223	6/1918	Elmer .....	2/2.5
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[73] Assignee: <b>The United States of America as represented by the Secretary of the Army, Washington, D.C.</b>	2,399,184	4/1946	Heckert .....	161/404 X
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[21] Appl. No.: **368,905**

[52] U.S. Cl..... **161/37, 161/44, 161/404 X, 2/2.5, 109/49.5, 156/258, 52/592**

[51] Int. Cl..... **B32b 3/16**

[58] Field of Search..... 161/37, 42, 43, 44, 149, 161/404, 49; 2/2.5, 51, 243 R; 109/49.5, 79; 156/258; 52/592

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### [57] ABSTRACT

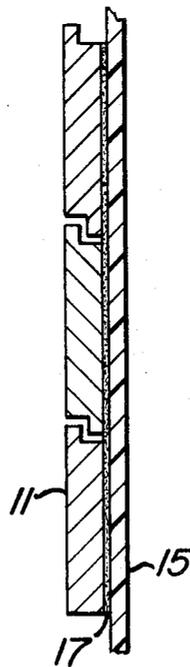
A flexible armor material comprising an array of platelets with contoured edges or reinforced joints supported by a flexible membrane.

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**5 Claims, 8 Drawing Figures**



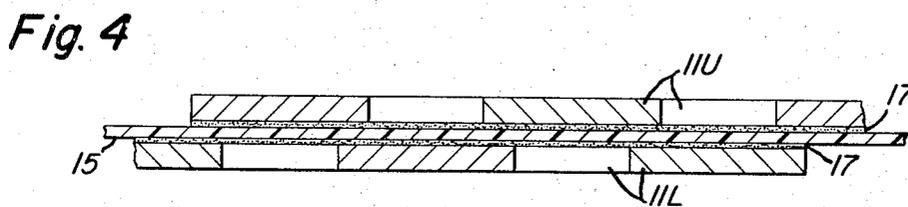
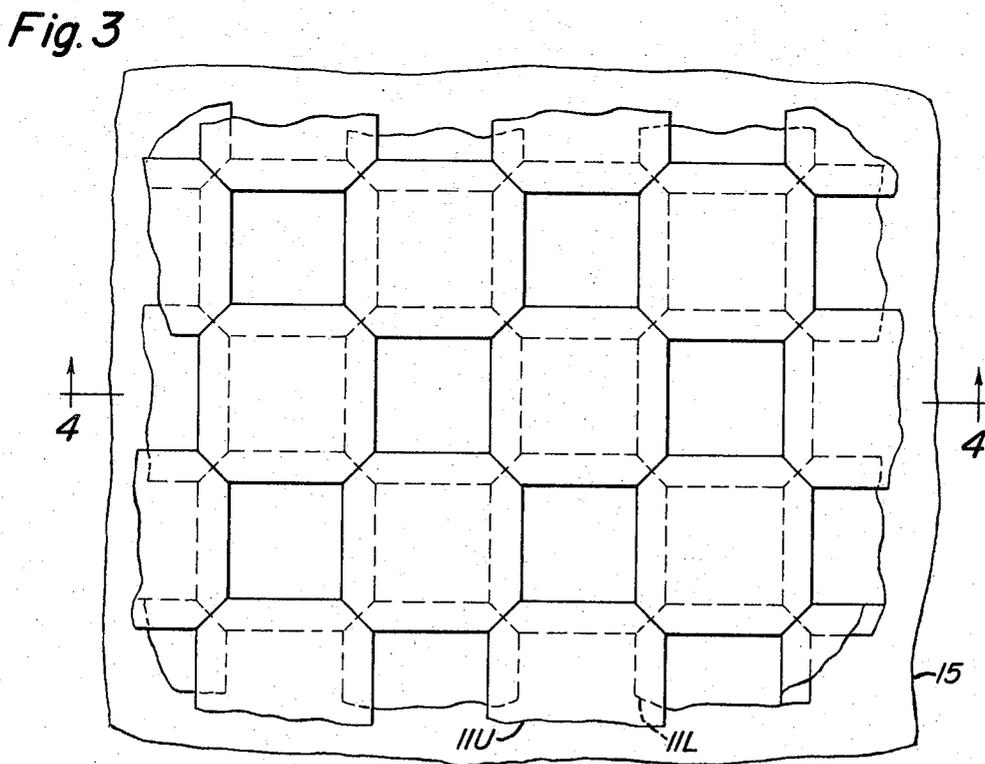
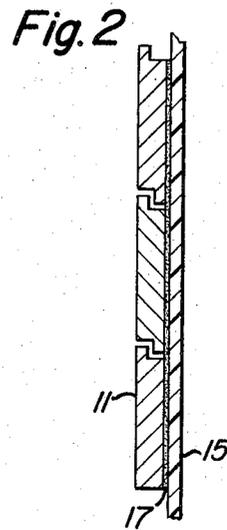
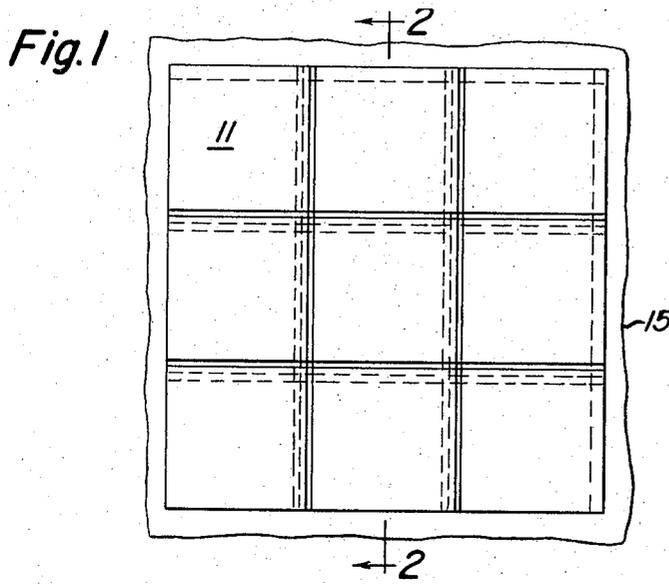


Fig. 5

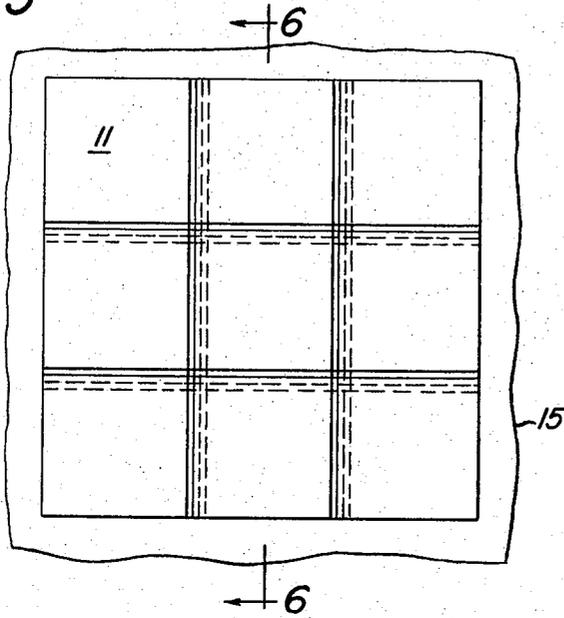


Fig. 6

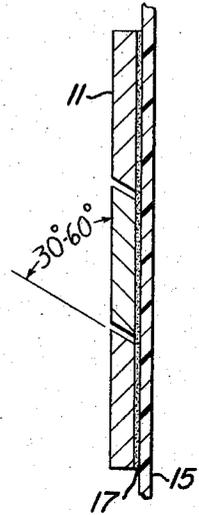


Fig. 7

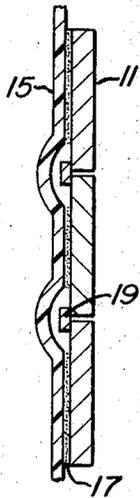
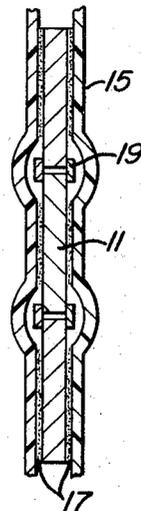


Fig. 8



**BODY ARMOR CONSTRUCTION**

The invention described herein may be manufactured, used, and licensed by or for the Government for governmental purposes without the payment to us of any royalty thereon.

This invention relates to a flexible armor material consisting of an array of platelets supported on a flexible membrane, so that when designed into a garment, the array of platelets will conform to the body contours of the wearer and be capable of adjusting to his movements even during violent physical motion.

**BACKGROUND OF THE INVENTION**

The customary arrangements for platelet constructions that more or less completely cover a body area to be protected are those of butted plates, or of overlapping plates. Butted joints gape open when the joint is flexed leaving a zone between plates that has no protection. Although butted platelets with thickened rims overcome the loss of resistance at the joint line to penetration by projectiles, they too are subject to gaps when the joints are flexed. Overlapping constructions have three plates overlapping at corners. These constructions are needlessly heavy and bulky because of the triple overlap.

**SUMMARY OF THE INVENTION**

This invention pertains to improved joint construction for butted, scarf and overlapped joints in which platelets are mounted on one or more supporting fabrics, membranes or netting.

It is an object of the present invention to provide and disclose an improved flexible lightweight body armor.

It is a further object of the invention to provide and disclose a flexible lightweight body armor capable of being designed into a garment which conforms to the body contours of the wearer.

It is a further object of the invention to provide and disclose a flexible lightweight body armor capable of adjusting to the movements of the wearer even during violent physical activity.

It is a further object of this invention to provide and disclose a flexible, lightweight armor comprising improved overlapped joints construction mounted on one or more supporting fabrics.

It is a further object of this invention to provide and disclose a flexible lightweight armor comprising improved butted joint constructions mounted on one or more supporting fabrics.

**BRIEF DESCRIPTION OF THE DRAWINGS**

Other objects and a fuller understanding of the invention may be had by referring to the following description and claims taken in conjunction with the accompanying drawing in which:

FIG. 1 is an illustration of a top view of an array of square platelets comprising an improved overlapped joint construction mounted on supporting fabric.

FIG. 2 is a vertical sectional view through 2-2 of FIG. 1.

FIG. 3 is an illustration of a top view of an array of square platelets positioned in one horizontal plane having chamfered corners in order to permit overlap with a second array of platelets positioned on a second horizontal plane proximate thereto.

FIG. 4 is an illustration of a vertical sectional view through 4-4 of FIG. 3.

FIG. 5 is an illustration of a top view of an array of square platelets comprising an improved scarf joint construction mounted on a supporting fabric.

FIG. 6 is a vertical sectional view through 6-6 of FIG. 5.

FIG. 7 is a vertical sectional illustration of an improved butted joint construction mounted on a supporting fabric.

FIG. 8 is a vertical sectional illustration of an alternative of FIG. 7.

**DESCRIPTION OF THE PREFERRED EMBODIMENTS**

Referring now to the drawing, FIG. 1 generally illustrates the nature of the invention. The system comprises an array of square platelets designated 11 laying in one plane and with each one having a step-joint as shown in FIG. 2. Supporting material 15 is bonded to one side thereof by bonding material 17. A preferred width of the step is approximately the same dimension as the thickness of the plate as illustrated in FIG. 2. Fabrication of the step is more easily accomplished with a two layered platelet where the stepping can be achieved by positioning of layers of the same size during assembly of the platelets.

Improved overlap joint constructions are shown in FIGS. 3 and 4. The corners of the square platelets are chamfered to permit overlap with the platelets being only in the two horizontal planes rather than the three or more that would result with nonchamfered squares. Platelets in a plane are in contact with each other only at the chamfered corners. The amount of chamfer determines the overlap of an upper plate (11U) on lower plate (11L) as shown in FIG. 4. Preferably, the amount of overlap is at least one half the platelet thickness, but not less than one-eighth inch. The supporting membrane in this construction lies between the two planes of platelets. Additional membranes may be used on either or both outer sides of the platelets.

FIGS. 5 and 6 illustrate an alternative of the present invention comprising a scarf joint type of construction wherein the platelet 11 lay in one plane. The angle of the joint may be within a practical range of 30° to 60°.

Simple butt joints may be improved by the use of reinforcing strips 19 over the joints. Strip 19 may be positioned on one or both sides of the armor as shown in FIGS. 7 and 8. In addition, supporting material 15 is distorted so as to curve away from reinforcing strip 19 having an air space between the supporting membrane and reinforcing strip 19.

The platelets may be constructed of any effective armor material such as aluminum, titanium, steel, glass-reinforced plastic, borosilicate glass — glass reinforced plastic composite, bonded nylon fabric, nylon felt, and multilayered plastic film assemblies. Feasible thicknesses range up to one half inch.

Membrane material may be selected from a variety of materials depending on flexibility and strength required. A vinyl plastisol, Shore A hardness 42-55, 1200 psi minimum tensile strength and 340 percent minimum elongation and about 0.040 inch in thickness on one or both sides of the platelet is one example. A foamed vinyl plastisol of about one-sixteenth inch to one-eighth inch is another. Other possible membrane materials include polyurethane sheet, two-way stretch fabrics and nettings of various materials. The latter two

may also be incorporated into membranes as reinforcements for strength and durability.

The membranes may be preferable self-adhering to the platelets or bonded to the platelets by an adhesive. Various techniques may be employed to attach the platelets to the membrane. These techniques include: (a) casting a vinyl plastisol directly onto the platelet assembly, (b) applying a membrane to both sides of the platelet assembly with a suitable adhesive using contact pressure and/or heat, and (c) applying membrane to both sides of the platelet assembly with a suitable adhesive using a vacuum forming process with or without heat.

Although we have described our invention with a certain degree of particularity, it is understood that the present disclosure has been made by way of example, and that various materials and combinations thereof may be utilized without departing from the spirit and scope of the invention.

Having described our invention, we claim:

1. A flexible personnel armor material adapted to be compatible with the contours of a human body, said armor material comprising:

- a flexible membrane material;
- an array of platelets overlaying said membrane, said platelets having a stepped joint configuration so that the platelets lay in substantially one plane while the joints overlap each other, and;
- means affixing said platelets to said flexible membrane.

2. A flexible personnel armor material adapted to be compatible with the contours of a human body, said armor material comprising:

- a flexible membrane material;
- a first array of square platelets affixed to one side of said flexible membrane, said platelets having chamfered corners and abutting each other;
- a second array of square chamfered corner platelets affixed to the other side of said membrane in abutting relationship and so positioned with respect to said first array that the edges of the platelets of the first array overlaps the edges of the platelets of the second array.

3. A flexible personnel armor material adapted to be compatible with the contours of a human body, said armor material comprising:

- a flexible supporting membrane;
- an array of square platelets overlaying said membrane and being bonded thereto, said platelets further having scarf joints whereby the joints overlap each other and the platelets lay in substantially one plane.

4. A flexible personnel armor material adapted to be compatible with the contours of a human body comprising an array of platelets having butt-joints, a reinforcement strip positioned over the immediate butt-joints on the impact side of the platelets, a flexible supporting membrane positioned over the reinforcement strips, said supporting material being distorted so as to create an air-space over the immediate area of the reinforcement strips and butt-joints.

5. A flexible personnel armor material in accordance with claim 4 consisting of reinforcement strips and a flexible supporting membrane on both sides of the platelets.

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